

GPS-Based Driver Assistance System Makes Mountain Pass Opening Safer

RESULTS: AHMCT researchers are developing a driver assistance system for mountain pass opening. The portable system provides the operator with a display indicating location and height above the road, vehicle heading, vehicle pitch and roll, and system status. Sensing is provided by GPS with satellite-based differential corrections, along with a digital magnetic compass for heading.

Why We Are Pursuing This Research

Some mountain pass roads are closed over the winter, and buried deep in snow by the spring—opening these passes is a difficult and dangerous job. There are few indicators to help find the road, and over time some of these indicators may no longer be available. The current research will develop a system to provide the operator with a visual display that will help them find the road, and safely and efficiently open the pass to the traveling public.

What We Are Doing

AHMCT researchers are developing a driver-assistance system to support mountain pass opening. The system will provide an in-cab display for the operator, providing all the essential information to allow them to safely, efficiently, and accurately guide the vehicle over the roadway, even when the road is obscured by over thirty feet of snow. Since the smaller rotary plows used for this operation are often shared among maintenance yards, and the road opening operation occurs at varying times in each area, the researchers are developing a portable system. In particular, the system will be designed so it is easily installed, calibrated, and removed, and will work on a variety of vehicle types.

The system determines vehicle location using the Global Positioning System (GPS). Accuracy of uncorrected GPS is not sufficient for the current application. To safely find the road center and keep the vehicle over the road, sub-meter accuracy is crucial. However, many locations do not have the necessary infrastructure, a differential base station, to provide this level of accuracy. To achieve the accuracy desired while avoiding additional infrastructure, the current system uses a Satellite-Based Augmentation System (SBAS) to provide differential corrections, and achieves 10-cm accuracy (4 inches). This is more than sufficient for the current task, and the SBAS signal is available continent-wide.



Figure 1 - SR-108 is under here.... Somewhere...

Vehicle heading vs. the road heading is also essential, so that the blower operator can continue moving along the road. A digital compass provides the magnetic heading of the vehicle, which allows representation on the display vs. the road heading. In addition, roll and pitch of the vehicle may be important, as some rotary blowers will not operate if roll and pitch exceed a safety threshold. Even for vehicles which do not have this safety feature, the operators will be safer with this information available.



Figure 2 - Caltrans plows get down on the road

The system also provides height above the roadway, as well as text-based information indicating how far along the current pass opening has advanced, e.g. milepost readings. The GPS again provides this information. Underlying the GPS sensing, a key part of the system is the Geographic Information System (GIS) database, which includes information on the roadway location (centerline, shoulders, lanes), as well as roadside features, including signs. From this GIS, the system can determine location along the road, and provide the operator with milepost numbers, as well as text messages for familiar local landmarks, upcoming intersections, and system status.

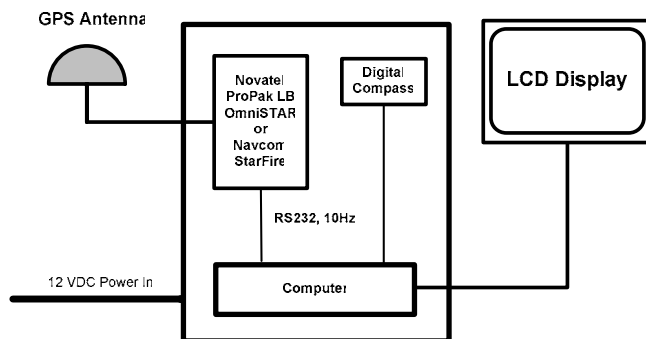


Figure 3 - Pass-Opening system configuration

To assure safety, the system includes a watchdog feature, and status indicators for all sensing systems. The status indicators provide an immediate indication of the function of the system, e.g. whether the GPS receiver sees enough satellites, whether there is differential correction information available, etc. In addition, a watchdog subsystem monitors the overall code execution, and provides a pulsing heartbeat. In the rare circumstance of a system freeze, this heartbeat would also stop, and the operator could tell that the system was no longer reliable. In normal conditions, if the sensing degrades (e.g. due to loss of satellites) beyond an acceptable level, the operator is notified and the system will not provide faulty guidance information.

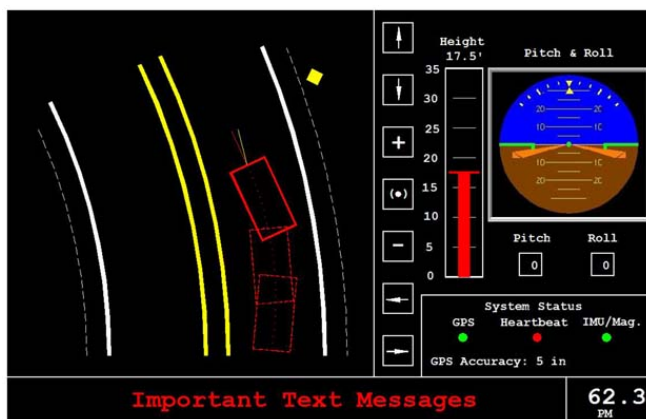


Figure 4 - The operator can find the road with the display



Figure 5 – Caltrans SR-108 pass-opening, Spring 2003

The Researchers Recommend

The system is in active development through the winter of 2003-2004. Researchers will test the system during the opening of Sonora Pass on State Route 108, north of Yosemite, CA. Based on preliminary results, including GPS testing on SR-108 and prototype testing and demonstration at Kingvale, providing GPS-based driver assistance for mountain pass opening does appear feasible, and holds great promise for enhancing the safety and efficiency of this operation. The researchers will update this flyer once the spring 2004 pass opening tests are complete, and will assess future directions for the research and development of this system. Based on the state-of-the-art and the trends in GPS system performance and cost, pass opening should be both feasible and cost-effective, and commercial prospects are promising.

For Additional Information

Larry Baumeister* (916) 324-2296 Larry_Baumeister@dot.ca.gov
 Ty A. Lasky♥ (530) 752-6366 talasky@ucdavis.edu
 Kin S. Yen♦ (530) 754-7401 ksyen@ucdavis.edu
 Bahram Ravani* (530) 754-6130 bravani@ucdavis.edu

Visit us at www.ahmct.ucdavis.edu

This document is disseminated in the interest of information exchange. The contents do not necessarily reflect the official views or policies of the AHMCT Research Center, the University of California, the State of California, or the Federal Highway Administration. This document does not constitute a standard, specification, regulation, or imply endorsement of the conclusions or recommendations. (rev. April 2004)

* Caltrans Project Manager

♥ Research engineer for this project

♦ Primary contact for this project

* Principal investigator for this project